

Appl. No. 09/888,256

Page 2 of 12

IN THE CLAIMS

Please enter the amendments to the claims as shown below.

1. (previously amended) An electron source comprising:
an anode;
a cathode comprising a beam-receiving portion and an electron emitting portion, the beam-receiving portion having a substantially concave surface;
an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode; and
a lens adapted to direct the electromagnetic radiation beam onto the substantially concave surface of the beam-receiving portion of the cathode, whereby electrons are emitted from the electron emitting portion.

2-4. (cancelled)

B¹
5. (original) An electron source according to claim 1 wherein the electron emitting portion comprises tungsten.

6. (original) An electron source according to claim 1 wherein the cathode comprises a rod that terminates in the electron emitting portion, and wherein the lens is attached to the rod.

7. (original) An electron source according to claim 1 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

8. (original) An electron source according to claim 1 wherein the lens comprises aluminum oxide.

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Appl. No. 09/888,256

Page 3 of 12

9. (original) An electron source according to claim 1 comprising an electromagnetic radiation detector to detect radiation reflected from the cathode to determine a property of the cathode.

10. (previously amended) An electron beam apparatus to register an electron beam pattern on a substrate, the apparatus comprising:

a vacuum chamber;

a substrate support to support a substrate;

B' coord.
an electron source to provide an electron beam in the vacuum chamber, the electron source comprising (a) an anode, (b) a cathode comprising a beam-receiving portion and an electron emitting portion, the beam-receiving portion having a substantially concave surface, (c) an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode, and (d) a lens adapted to direct the electromagnetic radiation beam onto the substantially concave surface of the beam-receiving portion of the cathode; and

an electron beam modulator and scanner to modulate and scan the electron beam across the substrate to register an electron beam pattern on the substrate,

whereby electrons are emitted from the electron emitting portion.

11-13. (cancelled)

14. (original) An apparatus according to claim 10 wherein the electron emitting portion comprises tungsten.

15. (previously amended) An apparatus according to claim 10 comprising a rod that connects the lens and the beam-receiving portion of the cathode.

S:\CLIENT\APPLIED\ETEC\Ebeam ELBM4978\AMEND.002.doc

Appl. No. 09/888,256

Pag 4 of 12

16. (original) An apparatus according to claim 10 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

17. (original) An apparatus according to claim 10 wherein the lens comprises aluminum oxide.

18. (original) An apparatus according to claim 10 wherein the electron source comprises an electromagnetic radiation detector to detect electromagnetic radiation emitted from the cathode to determine a property of the cathode.

B' cnt.
19. (previously amended) A method of generating electrons from an electron source comprising an anode, and a cathode having an electron emitting portion, the method comprising:

- (a) negatively biasing the cathode relative to the anode; and
- (b) heating the cathode to at least about 1800 Kelvin by directing an electromagnetic radiation beam onto the cathode.

20. (original) A method according to claim 19 comprising directing the electromagnetic radiation beam onto a beam-receiving portion of the cathode.

21. (cancelled)

22. (original) A method according to claim 19 comprising detecting a radiation reflected from the cathode and determining a property of the cathode.

23. (original) An electron source comprising:
an anode;

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Appl. No. 09/888,256

Page 5 of 12

a cathode comprising an electron emitting portion having a tip, a beam-receiving portion, and a cathode axis;

a laser beam source adapted to generate a laser beam to heat the cathode; and

a lens adapted to focus the laser beam onto the cathode, the lens being supported by a rod that is substantially parallel to the cathode axis and terminates in the electron emitting portion of the cathode.

24. (original) An electron source according to claim 23 wherein the lens comprises a lens axis that forms an acute angle with or is substantially parallel to, the cathode axis.

B' cont.
25. (original) An electron source according to claim 23 wherein the beam-receiving portion is a different portion of the cathode than the electron emitting portion.

26. (original) An electron source according to claim 23 wherein the beam-receiving portion comprises a substantially concave surface.

27. (original) An electron source according to claim 23 wherein the electron emitting portion comprises tungsten.

28. (original) An electron source according to claim 23 wherein the electromagnetic radiation source is adapted to heat the cathode to at least about 1800 Kelvin.

29. (original) An electron source according to claim 23 wherein the lens comprises aluminum oxide.

S:\CLIENT\APPLIED\ETEC\Ebeam_ELBMM4978\AMEND.002.doc

Appl. No. 09/888,256

Page 6 of 12

30. (original) An electron source according to claim 23 comprising an electromagnetic radiation detector to detect radiation reflected from the cathode to determine a property of the cathode.

31. (previously amended) A method of registering an electron beam pattern on a substrate, the method comprising:

(a) placing a substrate on a substrate support;
(b) generating an electron beam by (i) biasing a cathode relative to an anode, and (ii) heating the cathode to at least about 1800 Kelvin by generating an electromagnetic radiation beam and directing the electromagnetic radiation beam onto the cathode; and

(c) modulating and scanning the electron beam across the substrate to register an electron beam pattern on the substrate.

32. (original) A method according to claim 35 comprising directing the electromagnetic radiation beam on a beam-receiving portion of the cathode.

33. (cancelled)

S:\CLIENT\APPLIED\ETEC\beam ELBM4978\AMEND.002.doc

Appl. No. 09/888,256

Page 7 of 12

34. (original) An electron source comprising:
an anode;
a cathode comprising an electron emitting portion and a rod that terminates in the electron emitting portion;
an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode; and
a lens attached to the rod and adapted to direct the electromagnetic radiation beam onto the cathode,
whereby electrons are emitted from the electron emitting portion.

35. (original) An electron beam apparatus to register an electron beam pattern on a substrate, the apparatus comprising:
a vacuum chamber;
a substrate support to support a substrate;
an electron source to provide an electron beam in the vacuum chamber, the electron source comprising (a) an anode, (b) a cathode comprising an electron emitting portion and a rod that terminates in the electron emitting portion, (c) an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode, and (d) a lens attached to the rod and adapted to direct the electromagnetic radiation beam onto the cathode; and
an electron beam modulator and scanner to modulate and scan the electron beam across the substrate to register an electron beam pattern on the substrate,
whereby electrons are emitted from the electron emitting portion.

S:\CLIENT\APPLIED\ETEC\Ebeam ELBM4978\AMEND.002.doc

Appl. No. 09/888,256

Page 8 of 12

36. (original) A method of generating electrons from an electron source comprising an anode, and a cathode having an electron emitting portion, the method comprising:

- (a) negatively biasing the cathode relative to the anode;
- (b) directing an electromagnetic radiation beam onto the cathode; and
- (c) determining a temperature of the cathode and adjusting the amount of heat applied to the cathode.

37. (original) An electron source comprising:

- Cont.*
- an anode;
 - a cathode comprising an electron emitting portion;
 - an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode;
 - a lens adapted to direct the electromagnetic radiation beam onto the cathode; and
 - a thermostat adapted to determine a temperature of the cathode and adjust the amount of heat applied to the cathode,
- whereby electrons are emitted from the electron emitting portion.

38. (original) An electron source comprising:

- an anode;
 - a cathode comprising an electron emitting portion;
 - an electromagnetic radiation source adapted to heat the cathode to at least about 1800 Kelvin by generating an electromagnetic radiation beam; and
 - a lens adapted to direct the electromagnetic radiation beam onto the cathode,
- whereby electrons are emitted from the electron emitting portion.

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Appl. No. 09/888,256

Page 9 of 12

39. (original) An electron source according to claim 1 wherein the cathode has a cathode axis, and wherein the lens has a lens axis that forms an acute angle with, or is substantially parallel to, the cathode axis.

40. (original) An apparatus according to claim 10 wherein the cathode has a cathode axis, and wherein the lens has a lens axis that forms an acute angle with, or is substantially parallel to, the cathode axis.

41. (original) A method according to claim 19 wherein the beam-receiving portion of the cathode comprises a substantially concave surface, comprising directing the electromagnetic radiation beam onto the substantially concave surface of the beam-receiving portion.

42. (original) A method according to claim 31 wherein the beam-receiving portion of the cathode comprises a substantially concave surface, comprising directing the electromagnetic radiation beam onto the substantially concave surface of the beam-receiving portion.

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Appl. No. 09/888,256

Page 10 of 12

43. (new) An electron source comprising:
an anode;
a cathode comprising an electron emitting portion and a beam-receiving portion, the beam-receiving portion comprising metal;
an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode; and
a lens adapted to direct the electromagnetic radiation beam onto the beam-receiving portion of the cathode,
whereby electrons are emitted from the electron emitting portion.

Bind.

44. (new) An electron beam apparatus to register an electron beam pattern on a substrate, the apparatus comprising:
a vacuum chamber;
a substrate support to support a substrate;
an electron source to provide an electron beam in the vacuum chamber, the electron source comprising (a) an anode, (b) a cathode comprising an electron emitting portion and a beam-receiving portion, the beam-receiving portion comprising metal, (c) an electromagnetic radiation source adapted to generate an electromagnetic radiation beam to heat the cathode, and (d) a lens adapted to direct the electromagnetic radiation beam onto the beam-receiving portion of the cathode; and
an electron beam modulator and scanner to modulate and scan the electron beam across the substrate to register an electron beam pattern on the substrate,
whereby electrons are emitted from the electron emitting portion.

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